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# The Magic Lantern Gazette

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# Winter Dissolving Views

What a queer, pretty picture it is that greets me, as I turn my back to the rushing flakes, and so get my eyes open to look at it. Beyond a wide swale, that yesterday was gold and green but now is glistening wintry white, rises a small eminence, where a **dissolving view** of trees and buildings is momentarily formed, then hidden, then brought out again, mirage-like, in the most curious and dreamlike unreality, yet always with singular beauty. Gray is the only color, a soft, purplish, silvery gray; and the silhouette is the only style of drawing. By their outlines I guess that the wavering slender spike amid the glistening haze is the church steeple—that squarish blur the belfry of the court-house—the next irregular smudge a certain collection of house-roofs; but all seem as foreign and unsubstantial as shadows, so quaintly are they now clouded, now lightly revealed by the swirling, satiny snowflakes that fill the air with particle luminous in themselves yet obscuring the landscape.

Ernest Ingersoll, "In March Weather,"
*Outlook*, March 4, 1899

In our main feature article, John Davidson has contributed a rather technical piece on the use of antique and modern electric lights for magic lantern projection. He has included not only descriptions of the various sorts of lamps, but also experimental data on the brightness of each type of lamp. Those not mathematically inclined may wish to skip over the equations in his article and focus on the practical information he provides on the various types of lights. Because of potential damage to lantern slides from heat and from both visible light and ultraviolet radiation, he recommends the use of the lowest intensity lights that are practical for a particular size of audience and venue.

The length of the Davidson article did not leave much space for other material, but there is the annual financial report of the society, which will make for exciting reading for most members, and a short Research Page summarizing some interesting academic articles related to magic lanterns. I also have repeated on p. 23 the earlier announcement of our Student Essay Award.

Please check out the Magic Lantern Research Group at https://www.zotero.org/groups/magic_lantern_research_group. This site is accessible to the public and best viewed using Mozilla Firefox as the web browser. In the Group Library, you will find links to all back issues of *The Magic Lantern Gazette* and *Magic Lantern Bulletin* online through the San Diego State University Library. You also will have access to hundreds of web pages related to magic lanterns, hundreds of copyright-free digital books going back to the 17th century, a comprehensive bibliography of scholarly articles on the magic lantern, mostly from the 1970s to the present, and much other useful research material. You also can contact me for information on how to join the Magic Lantern Research Group .

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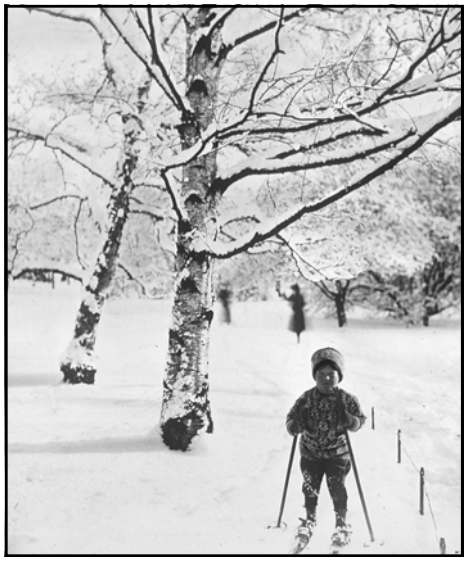

Three lantern slides of children playing in the snow. Wells collection.

# Electric Incandescent Light Sources for the Magic Lantern, Old and New

See Corrections to this article provided on the last two pages of this pdf.

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On October 21, 1879, at Menlo Park, New Jersey, the world started to become a brighter place, for it was on this day that Thomas Alva Edison beat out his rivals and created the first potentially successful incandescent electric lamp. It burned for over 45 hours. How long it would have lasted we will never know, because Edison yielded to the temptation to force the lamp to a greater brilliance by applying a higher voltage and burned it out. An exact replica made in 1890-91 in the course of patent litigation burned for 600 hours. That first lamp was broken open and the filament, a piece of carbonized sewing thread, was examined microscopically, thus depriving the world of an historic relic.

Unlike Edison's rivals in the United States, chiefly Hiram Maxim and the stormy partnership of Sawyer and Mann, Edison had thought out and had calculations made by his mathematician, Frances R. Upton, on an entire system of electrical lighting. This system, analogous to the one already in place for gas, included generators in a central station, wiring and distribution layouts, and even a device for measuring the electricity used by the customer. An essential part of the system was the lamp itself, which Edison determined had to have a relatively high electrical resistance of ca. 200 ohms for a 100 volt lighting circuit, a specification which most of his competitors had missed. A high resistance lamp draws less current for a given voltage than one of low resistance, and this means that the wires could be made smaller in diameter and hence much cheaper. Current draw determines the diameter of the wire, whereas voltage determines the insulation requirements. The product of voltage and amperage drawn determines the wattage in the direct current (DC) system that Edison designed.

That first filament of carbonized sewing thread was the beginning of a long line of steadily improved carbon filament lamps, which lasted for about 26 years[1], and just when and if carbon filament lamps were used in the magic lantern is difficult to determine. The author has a lamp with a spiral cone-shaped filament that appears to be made of carbon, dating from about 1910, which could have served as a magic lantern light source. It is shown in **Plate 1**. The vast majority of pre-1900 lamps had long looping filaments and were of low wattage and of low light output (lumens per watt), and thus would have been poorly suited to the magic lantern **(Plate 2).**

**Plate 1**

**A 106 ohm carbon filament lamp that could have served as a magic lantern illuminant. A similar bulb but without the tip was rated at 200 watts at 115 volts and had a resistance of 120 ohms. Note the darkening of the bulb due to evaporated carbon**

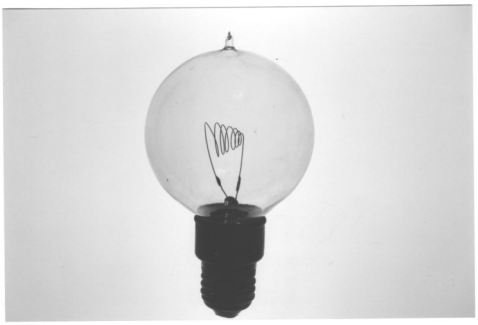
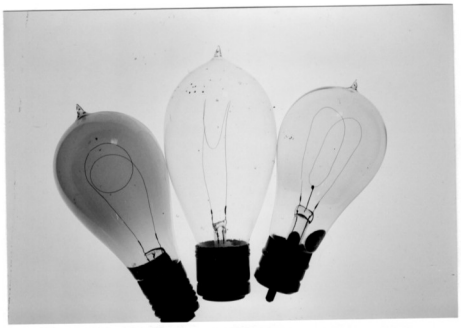


**Plate 2**

**Pre-1900 carbon filament lamps, Left, lamp with Edison base which shows heavy darkening due to extensive use. Center, Tomson-Houston lamp. Right, Sawyer- Mann lamp. Edison filed for a patent on Dec. 19,1879 but the patent was not granted until 1891 due to interference actions by rival inventors such as Sawyer and Mann**



It is the job of the condenser lens combination to evenly illuminate the slide, and this is accomplished by bringing the filament of an incandescent electric light source to a focus at the projection lens. If the lamp is properly chosen and adjusted, an image of the entire filament should be seen centered on the front surface of the projection lens when viewed from the side, but not in the projected illumination. Checking the lantern in this way will ensure that the lamp is properly centered. With large sources such as oil lamp flames or frosted incandescent lamps, generally only a portion of the source will be imaged on the projection lens, so illumination efficiency will be low. Thus, projection bulbs have filaments that are compact and occupy a relatively small area. More will be said of this when we consider modern replacements for antique light sources.

**Dating Historic Bulbs**

Incandescent lamps can be dated roughly by their construction. The universal screw base used today was pioneered by Edison and is supposedly based on the cap of a kerosene can in Edison's Menlo Park laboratory.[2] Other manufacturers used different arrangements, and any non-standard base on a general purpose lamp dates the lamp as pre-1900. The wires that are fused through the glass to make a vacuum-tight seal must match the expansion coefficient of the glass used, and the only suitable material known in the 19th century was platinum. Platinum sealed through glass appears silvery white and would date the lamp to before 1911-1913. After these dates, a composite metal wire (Dumet ™) was used, consisting of a core of 45% nickel and 55% iron, clad first in copper and then in brass.[3] Other sources say the brass cladding was first, with the copper on top. Later the brass was omitted entirely, and only copper was used.[4] These seals appear reddish in color, due to a borax coating to improve adhesion and are used today in general purpose lamps made of soda lime, or " soft glass." The copper also ensured a wire of lower electrical resistance. Projection bulbs are sometimes made of heat resistant borosilicate glass and generally have tungsten-lead through wires. These appear yellow to brown in color when sealed through glass. Borosilicate glasses were introduced in 1912 by the Corning Glass Works under the trade mark Pyrex ™ .

Early light bulbs were "vacuum lamps" and were attached to the vacuum pumps by a tube attached to the top of the lamp. After evacuation, the bulb was sealed off, leaving a tip at the top of the bulb. Tipless bulbs first appeared in 1903, but did not become common until the Mitchell-White automatic sealing machine came into use. The tip at the top of the bulb totally disappeared after about 1910.

The early Edison lamps had an efficiency of 1.68 lumens per watt, a figure that was high enough to be more efficient and cheaper than gas lighting, which was practically universal in large American cities and was the chief competition with which Edison was concerned. This competitive edge was in a large part due to the highly efficient generator design that Edison had introduced, turning about 90% of the applied mechanical power into electrical power. Central generating stations were not practical in any but large cities, since Edison's direct current system could not transmit electrical power over long distances. By 1906, carbon filament lamps had been perfected to the point that the efficiency was up to about 3.4 lumens per watt. The period from 1906 to 1913 saw rapid improvement, with the introduction of the drawn tungsten wire filament and the gas-filled lamp.

Gas filling of a lamp slows down the evaporation of tungsten, just as walking through a crowd slows you down as compared to walking through an empty space. Just as you will move faster through a crowd of small children than one of adults, the efficiency of the method goes up with the molecular weight of the gas. At first Nitrogen (MW=28) was used, and later Argon (Atomic wt. = 40). Recently, so called long-life bulbs filled with Xenon (Atomic W t = 131.3) have been marketed. The gas must be inert to the lamp components and is at such a pressure that when the lamp is running, the pressure is nearly that of the atmosphere. Some of you may have seen failed 16mm movie projector bulbs that have a distinct bulge in the glass envelope near the filament, indicating that the bulb got too hot and the gas inside the bulb was actually able to bulge the hot glass! However it was this innovation that gradually brought the incandescent lamp to nearly its modern form, achieving efficiency as high as 15 lumens per watt for general purpose lamps.

All incandescent lamps evaporate the filament. Indeed, photographers who have used non-quartz halogen incandescent lighting are familiar with the gradual fall off of light intensity with time, due to the evaporated film of dark tungsten metal inside the bulb. This problem can be overcome by lamps of the quartz halogen construction widely introduced in the 1960s. A quartz halogen bulb has a small bulb made of high softening point clear quartz (nearly 1000° C), which contains iodine vapor.[5, 6] Quartz has such a low coefficient of expansion that a quartz rod may be heated red hot and plunged into water without breaking, a demonstration often used by quartz workers to impress onlookers. The small size of the quartz bulb means that it gets quite hot during operation and this is an essential feature of the quartz halogen lamp. During operation, the tungsten slowly evaporates, as in an ordinary tungsten lamp, but it reacts with the iodine vapor to form a clear tungsten iodine compound. Upon striking the heated bulb the clear compound is evaporated and eventually finds its way back to the filament, where it is decomposed back to tungsten metal and iodine, and the cycle begins again. It is important not to overcool a quartz halogen lamp, as the tungsten-iodine cycle could be interrupted and the bulb life considerably shortened. It is worth noting that quartz has a very high UV transmission, so a quartz halogen bulb puts out more UV light than a bulb made of Pyrex. The spectrum of light emitted by a tungsten filament lamp depends only on

the color temperature at which it is operated, not on its construction.

It is interesting to note that before the Edison carbon filament patents expired, the Waring Electric Lamp Company marketed a lamp containing bromine vapor at 0.002 of atmospheric pressure. The bromine vapor apparently reacted with the evaporated carbon and deposited a clear greenish compound of carbon and bromine on the inside of the bulb, instead of black light-absorbing carbon. Eventually the bromine was used up and the lamp became an ordinary vacuum lamp.[7] This lamp was invented by John Waring, who was shortly thereafter killed in a laboratory explosion, an occupational hazard of chemists.

**The Modern Replacement Lamp for the Historic Magic Lantern**

One rule to follow when choosing a replacement bulb for a magic lantern is this: **If you find or have a bulb you like, get a sufficient supply to last a lifetime, with perhaps about a 50% excess.** Incandescent lamps come and go! With the gradual disappearance of 35 mm slides, as well as 8 mm, 16 mm, and even 35 mm motion picture film, who knows how long many projection bulbs now available will be around in the future? When you go to the movies, chances are that what you see on the screen was transferred to a digital projector from a hard drive! Today a digital theater projection booth is empty of personnel; even the starting times of the shows are preprogrammed, so that aspect of the theater basically runs itself. Times are rapidly changing. The local Elyria, Ohio, camera store has a stock of old bulbs and claims that failure can run as high as 50%; hence the suggestion to get more than you think you will need.

When we buy a general purpose bulb, we usually purchase one of a similar wattage as the one we are replacing. With special purpose bulbs, we look for an exact replacement. All of this is of little help if we are in the process of choosing a bulb for an antique magic lantern, which may have come with no light source at all. The most important consideration in finding a retrofit bulb is **operating voltage**. This, along with the bulb wattage, is virtually always stated in a bulb's specifications. Clearly most of us will want a 115-120 volt lamp if we live in the United States or Canada. In the U.K. and Peru, you will want a 220 volt lamp, and if you plan to give shows outside of your normal country of residency, it is best to check the standard AC line voltages available. If different from the voltage you normally use, suitable transformers should be obtained, especially if you use SCR dimmers to create fades and dissolves. Remember that an SCR dimmer will only work on an alternating current line and on the voltage and frequency for which it is designed. Also remember that an SCR dimmer only works on incandescent lamps**,** or on a resistive load which amounts to the same thing. The SCR must thus be used after the transformer and just before the lamp.

If you plan to give shows where electricity is not available, there are a number of low-cost, highly efficient solid state AC inverters which run off 12-volt automobile batteries. Don't pick one that just barely meets your wattage requirements; get one with enough over capacity to ensure adequate operation. The author has a 700 watt model by Wagan Tech which gives 115volts AC out on 10-15 volts of DC input. It weighs just under 4.5 lbs. If you use two 200 watt FEV bulbs in a biunial lantern, your maximum wattage would be 400 watts. With both bulbs operating, which is seldom the case, a 50-amp-hour, 12-volt automobile storage battery would in theory give you 1.5 hours of operation, or three hours with only one bulb operating. However at high current drain, storage batteries do not give full output and so it is my guess that you probably would be safe for a one-hour show, maybe longer. If one battery is not sufficient, use two or more connected in parallel. Definitely try it out before you give your show, or you may be in the same situation as some lantern showmen were in the limelight days- "those who gassed too much literally ran out!!"

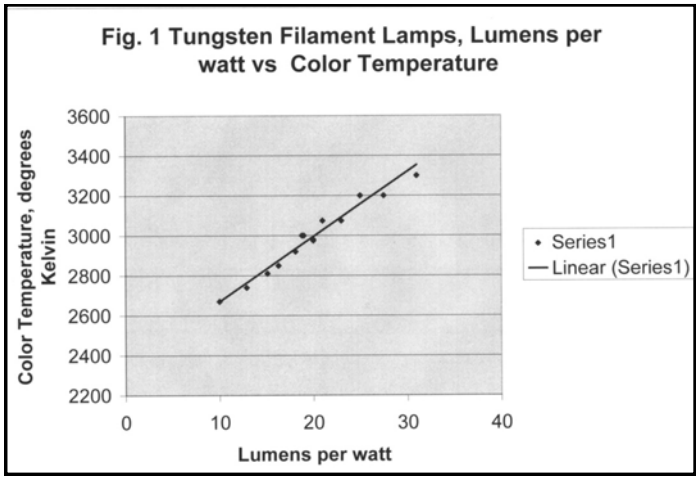
One of the fundamental design parameters with respect to an incandescent lamp is its **color temperature**, and with tungsten filament lamps, this is very close to the operating temperature of the lamp expressed on the absolute temperature scale in degrees Kelvin (degrees centigrade plus 273.15). The absolute temperature scale is based on a true zero value of the lowest temperature possible, which is minus 273.15 degrees centigrade. It is approached in the laboratory, but never reached. The color temperature of a lamp refers to the temperature of a perfect radiator/absorber or "black body" which emits the same spectrum as the lamp in question. Tungsten, technically called a "grey body" emitter, approaches this ideal condition, but even so, the color temperature is slightly higher than its operating temperature. For example, a lamp rated at 3200 degrees K will be operating at 3100 degrees K. In the listed specifications of a bulb, and certainly with those considered for projection applications, the color temperature is virtually always listed.

The **lumens output per watt** is directly related to the color temperature of an incandescent lamp in a linear manner over the range of interest. It is not mentioned in the references the author consulted, but the required data often are presented. A plot consisting of both literature and the author's experimental Russell angle data is presented in **Fig. 1**, and the equation of the line is given in Eq. 1:

Eq. 1) Color Temperature,( $CT\ ^{0}K$) = 30.23 (E) +2363

E = lumens per watt rating of bulb at a given voltage

This is a very useful expression, for as mentioned previously, the color temperature and wattage are nearly always stated for a given bulb. However the lumens output is sometimes not given, and this is especially true of bulbs with built in reflectors such as the MR-16 style reflectors.




The **life of an incandescent lamp** is chiefly determined by the rate of evaporation of the filament, which in turn is determined by the operating temperature, or what amounts to nearly the same thing, the color temperature of the filament. In general, the higher the color temperature of the filament, the shorter the bulb life will be. The quartz halogen lamp construction, as has been explained, greatly increases bulb life or conversely enabled the construction of bulbs of much higher color temperature, with lives of 25 to 50 hours. For example, the ELH bulb suggested for use in some models of Kodak Ektagraphic projectors is a quartz-halogen bulb with a color temperature of $3350^0$ K and has a life of 35 hours. This is on the order of the lives of standard gas filled lamps operating at a much lower color temperatures, which have been used for projection in the past. Curves published by Loveland[8] for ordinary gas filled lamps suggest a lifetime of about 10 hours for the ELH bulb. If the lifetime of a bulb at one color temperature and output (lumens) is known, or is calculated from Eq.1, the life at another color temperature can be estimated by the following relationship[9]:

Eq. 2) $L_1 / L_2 = (E_2 / E_1)$ exp (b)

L = life of bulb in hours at a lumens/watt rating (E),
b = a constant ranging from 6.5 to 7.5.[9]

The "life "of a bulb today is considered to be the number of hours in which 50% of the bulbs in a test lot fail, and modern values of b differ from those given in reference 9.

Modern research has yielded "long life" bulbs, which operate at a lower lumen per watt value, but have a much longer life. For example, a 100 watt GE long life general purpose bulb has a 1500 hour life at 1550 lumens, as compared to standard bulbs, with a life of 750 hours at 1690 lumens. These numbers yield a value of b in Eq. 2 of 8.326, or about 11% greater than the high value given for Eq. 2 as found in reference 9, published in 1928. Conversely, a Sylvania long life general purpose 100-watt bulb, when run at 130 volts, had a life 750 hours and a light output of 1700 lumens. The same bulb, when run at 120 volts, consumes 88 watts, but only gives out 1290 lumens, or 14.65 lumens per watt. These values gave a b value in Eq. 2 of 6.18, or 5% below the low value listed for b. Inspection of the latest Sylvania *Lamp and Ballast Catalogue* (ND) yielded 5 relatively low wattage 130 volt Quartz –Halogen bulbs which have twice the life when run at 120 volts. These bulbs yielded b values ranging from 4.2 to 4.94 via Eq. 2. This lower value is not too surprising, since the quartz halogen cycle represses filament evaporation which is the basic cause of bulb failure and thus less sensitive to filament temperature. The overall message is clear however; running a bulb below its rated voltage ***should*** greatly increases bulb life due to the high exponential dependency of bulb life on lumens per watt. This is not ***necessarily*** true for quartz halogen lamps, however.

As the above discussion of the Sylvania bulb illustrates, the light output of an incandescent bulb is a strong function of the voltage at which it is operated. If the light output at one voltage is known then the that at another can be estimated from Eq. 3.[11]

Eq. 3) $LL_1 / LL_2 = (V_1 / V_2)$ exp K

LL = lumens output when run at a voltage V (volts)
K = 3.51 for vacuum tungsten lamps

A similar form of expression relates the current drawn (I) in amperes to the voltage applied (V), again for vacuum tungsten lamps

Eq. 4) $I_1 :/ I_2 = (V_1 / V_2)$ exp T

T = 0.58

Loveland[12] gives the following relationships relating applied voltage (E) and the color temperature of (tungsten) filament lamps:

For direct current (DC):

Eq. 5) log CT = 1.042 log (V/I) + 2.024

For alternating current (AC):

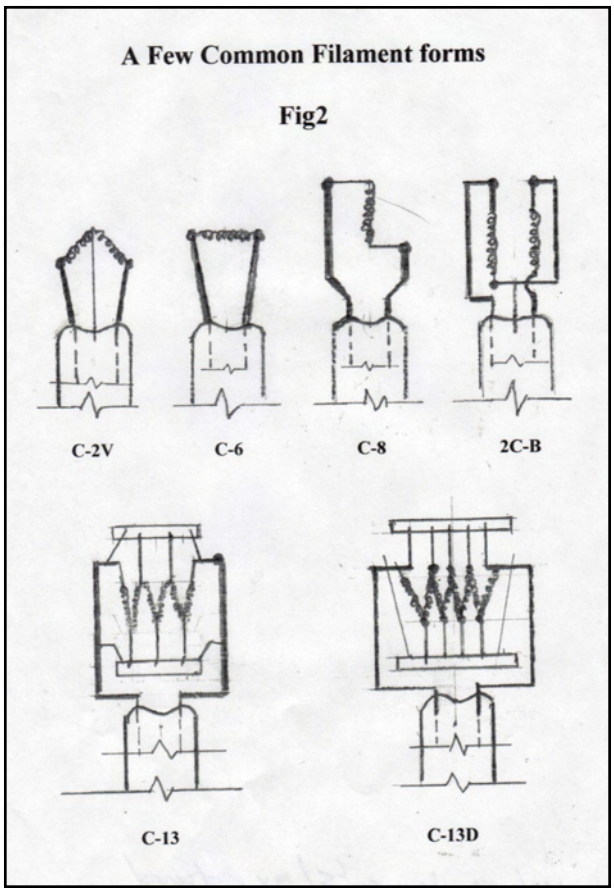
Eq. 6) log CT= 0.4025 log V + 2.684

In using Eq. 6, care should be taken to measure voltage across the lamp terminals and to make variations in voltage using a rheostat rather than a Variac, as the latter complicates matters. An SCR should not be used. Using Eq. 6 to predict the color temperature of the bulbs in Table 1 generally gives larger values than stated by the manufacturer and I feel it is of doubtful utility. Thus equations 1-4 express the basic properties of a tungsten incandescent lamp in mathematical form. As was mentioned previously, the color temperature,

life, operating voltage, and wattage are virtually always listed for a bulb intended for projection and from these data one can *estimate* its performance at other operating conditions. Remember that for incandescent lamps wattage divided by the voltage applied gives the current drawn in amperes.

**Filament Form and Bulb Shape**

As was mentioned earlier the filament of a projection bulb should be small and compact so that it can be imaged in its entirety by the condenser lens in the projection lens aperture**.** Filament forms are designated by an ANSI (American National Standards Institute) letter-number code, and a few of the common forms are shown and listed in **Fig 2**. The sketches in **Fig. 2** are not to scale, but are intended to show the general design features. Filaments may be designated (C) meaning coiled or (CC) double coiled. The filaments of the C -13 and C-130 style are often used for projection, but the author has used the FEV and ESR bulbs for many years and these have a C-2V type of filament. Bulb shapes are designated by an ANSI letter code and some of you may be familiar with the sealed beam internal reflector bulbs with the PAR designation used for outdoor lighting and formerly used for automobile headlights. Projection bulbs are often tubular (T) and occasionally pear shaped (P). Unless so designated, bulbs with built in reflectors (R) are not suitable for projection.




In **Table 1** are listed a number of bulbs of various wattages I think would be suitable or have been used in a magic lantern. I have had no experience with all but four, but merely present them as examples of what is available. There are many, many more. Clearly the smaller the lantern, the lower the wattage should be unless you are going to run the bulbs at lower than rated their voltage, or install a suitable cooling fan. **It should be noted that if you install a heat absorbing or reflecting filter before the condenser, that filter will require cooling even if the bulb does not.** By its very name, the filter will absorb or reflect heat and will increase temperatures, maybe with disastrous results to the filter unless that heat is removed by a proper cooling device.

For toy lanterns, especially small ones, one should not overlook the inexpensive 6 and 12 volt bulbs intended for automotive use and widely available at automobile parts stores. Look for ones with small compact filaments used for tail lights etc, not headlights. To run off of house current you will need a step-down transformer. A good source for them is:

**"All Electronics"**
**www.allelectronics.com**
**13928 Oxnard St.**
**Van Nuys Ca.91411**
**818-997-1806**

Be sure to get one with a higher volt-amp rating than the lamp wattage For resistive loads such as incandescent lamps, volt-amps and wattage are essentially equivalent. If you to fade your light source, remember that an SCR dimmer should not be used to feed a transformer; however, a variable autotransformer such as a Variac is suitable (See tech note #2). These are somewhat expensive and are also available from "All Electronics," but can be found at reasonable prices at flea markets. Two good sources for bulbs of all types are**:**

**Interlight**
**www.interlight.biz**
**800-743-0005**
**219-989-0060**

**Bulb Direct**
**www.bulbdirect.com**
**1 Fisher Road, Pittsford, NY**
**145349511**
**800-772-5267**
**585-385-3540**

The prices quoted in **Table 1** are from these two sources and of course subject to change without notice and since these bulbs are made by various manufacturers a given bulb may be quoted at different prices. Also there are many equivalent codes for the same bulb, but the order codes listed should enable you to find the designated bulb. Both of these sources also supply sockets for bulbs. Many long established camera stores have stocks of old bulbs available and of course there is Ebay.

**Table 1. Candidates for retrofit bulbs for magic lanterns, 120-118 volt lamps.**

| Watts | Filament size (mm) | °K | Lumens | Life (hrs) | Order code | Price | Base |
|---|---|---|---|---|---|---|---|
| 50 | 2.9 X 3.2 | 2850 | 780 | 50 | BLX | $4.50 | 1 |
| 100 | 5.8 X 5.8 | 3000 | 1880 | 50 | 100T 8.5/8 | $8.99 | 2 |
| 100 | 5.8 X 5.8 | 2850 | 1630 | 200 | 100G 16.5/29DC | $32.00 | 1 |
| 100 | 9.5-V | 3000 | 1880 | 1000 | ESR | $10.00 | 1 |
| 200 | 9.5-V | 3200 | 5500 | 50 | FEV | $10.78 | 1 |
| 250 | | 3250 | 7335* 5518# | 175 | ENH | $14.75 | 3 |
| 500 | | 3250 | 14500* 12590# | 25 | DEK | $29.95 | 4 |

Bulb bases: (1) BA15D, 15 mm double pin bayonet mount; (2) Med. Pf; (3) GY5.3 2-flat pin; (4) G17q-7, 3-4 pin base center post; appears to be an ordinary octal socket with center post for "radio tubes" etc.

* Calculated from Eq. 1. # Measured experimentally.

**Experiments With 4 Bulb Retrofits and 4 Lanterns**

The screen brightness and evenness of illumination was measured for 4 different bulbs, the FEV (200 w), ENH (250w), DEK (500w), and the BLC bulb (30w) (**Plate 3**). The ENH bulb has a built-in parabolic reflector around the bulb, while the DEK has a small metal plate behind the filament known as proximity reflector. Both of these latter two bulbs were used in various models of Kodak Carousel projectors. The magic lanterns used in this study included a science lantern by Griffin illustrated in **Plate 4**, A Brenkert model 01 biunial, and a model B Balopticon (carbon arc) lantern. These all probably date from the first quarter of the 20th century. A Perken, Son, and Rayment biunial was also employed, which probably dates from the 1890s and no doubt used limelight illuminants.

**FEV Bulb**

The Author has used both the ESR (100w) and the FEV (200w) interchangeable quartz-halogen bulbs in a variety of lanterns for many years with quite satisfactory results. These bulbs use a 2 pin, 15 mm bayonet mount and two other lamps in table 1 use the same. If *the room is dark* and the screen not overly large, I use the ESR bulb. I routinely use the FEV bulb with a 6 foot tripod screen and where the ambient light level is fairly high.

**Plate 3**

**Lamps tested in this work. From left to right, DEK bulb, 500w, note the "proximity reflector behind the filaments. FEV bulb, 200w and ENH bulb 250w The FEV is identical to the ESR 100w bulb and both have a 2 pin 15mm dia base.**

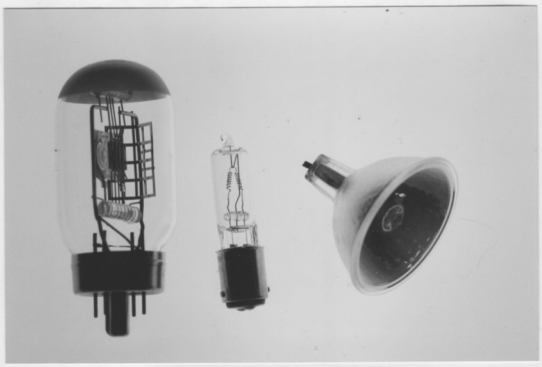


Plate 4. Griffin science lantern used in experiments.

To evaluate screen brightness and evenness of illumination, lux readings were taken at short periodic intervals across an axis passing through the center of the illuminated area. A 3-inch diameter clear area circular mask was placed in the gate of the projector in most cases, and circular symmetry assumed. Initially a tripod-mounted horizontal graduated rail was used to position the lux meter, but it was found much easier to stretch a cloth measuring tape vertically on the screen and carefully tape it in place. The lux meter could then be hand-held and its position easily noted. Typically measurements were taken every 3 inches across about a 4-foot illuminated circle. To determine the total lumens reaching the screen, a series of circular zones were identified by inspection of the profiles each with a constant or nearly constant level of illumination. By calculating the area of each zone in square feet and multiplying by the illumination level in foot candles the number of lumens en each zone was computed [( lux)(0.0929 ft candles per lux) = foot candles]. Summing up the lumens in each zone gave the total delivered to the screen. In the case of a square mask being used, the illuminated area was divided into a square grid, and the periodic lux readings averaged, a procedure which was much more time consuming than the case of a circular mask.

In **Fig. 3**, the illumination profile produced by a 200W FEV bulb in a Science lantern by Griffin is presented. A 3x3-inch empty slide carrier was used as a mask, and the profile was taken horizontally across the center of the illuminated area. This lantern has an unusual condenser configuration, as its two component lenses are separated by a space of 7.5 inches.

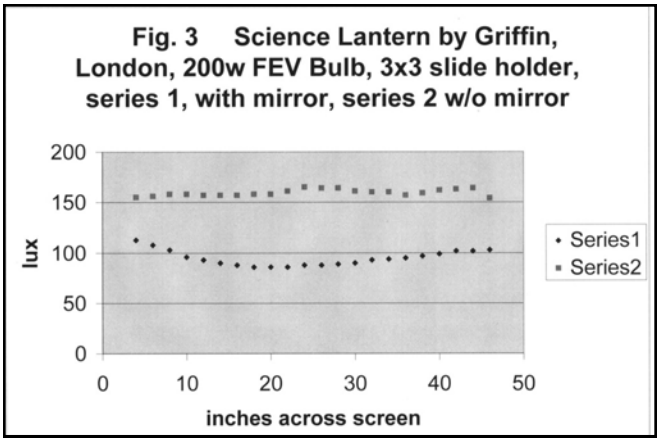
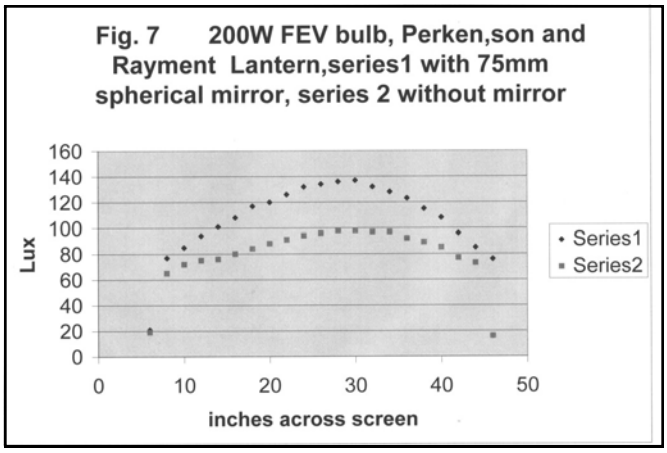



**Fig. 3 Science Lantern by Griffin, London, 200w FEV Bulb, 3x3 slide holder, series 1, with mirror, series 2 w/o mirror**

In **Fig. 3**, the illumination profile produced by a 200W FEV bulb in a Science lantern by Griffin is presented. A 3x3-inch empty slide carrier was used as a mask, and the profile was taken horizontally across the center of the illuminated area. This lantern has an unusual condenser configuration, as its two component lenses are separated by a space of 7.5 inches. This is to enable a plane mirror at 45 degrees to be put into position to illuminate an additional second front condenser element in the vertical plane. This is in turn is used to illuminate a horizontal slide holder. A separate projection lens and a 90 degree prism bring the image to the screen. This lantern probably dates from the first quarter of the 20th century and may have always used incandescent electrical illumination, as it came equipped with a suitable Edison base socket and a 4 inch spherical mirror. The lower line in **Fig. 3** represents the profile with the mirror removed. Note that this profile is slightly concave. The upper profile is with the mirror in place and is remarkably flat The general observation is that a mirror behind the light source in a magic lantern produces or enlarges a convex profile and creates a more or less "hot" center noticeable by foot candle measurement on a small projection screen. In this case the well designed optics of the Griffin lantern and the slightly concaved profile produced by the condensers is flattened out by the mirror to give surprisingly even illumination.

This should be contrasted with the profile produced by the same type of 200w FEV bulb installed in a Brenkert model 01 Biunial. This is shown in **Fig. 4**, series 2. Note that the illumination at the edge of the profile is ca. 25 % (about 1/3 stop) lower than that in the center. In this instance, a 3.25 x 4 empty slide carrier was used as a mask in the gate. The addition a 75mm diameter 150mm radius spherical mirror (Anchor Optics)[13] gave almost 40% more center illumination, but only about a 20% increase at the edges. Expansions of 2X and 3X are given in **Fig. 4A**.

In the search for an inexpensive spherical mirror, a 4-inch metal reflector from a new Justrite (TM) miner's calcium carbide lamp was tried, and the results are presented in **Fig. 5**.




**ENH (ENH-5) bulbs**

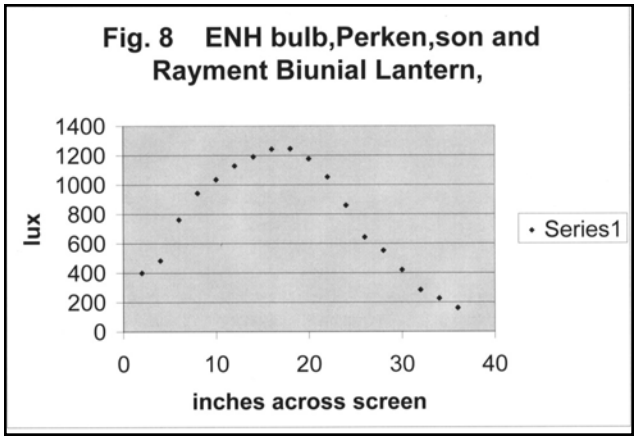
The ENH bulb is one of a number of bulbs with a GY5.3 base and an integral bulb surround mirror (MR-16), intended for audiovisual applications. A number of these rated at 120-125 volts along with their intended use are listed in **Table 2**.

The important thing to notice in table 2 is that the light delivered to the screen is only 4.6 to 9.8% of the total light generated by the bulb even with late 20th century projectors. We will see that percentage figures for the magic lantern are not too much lower!

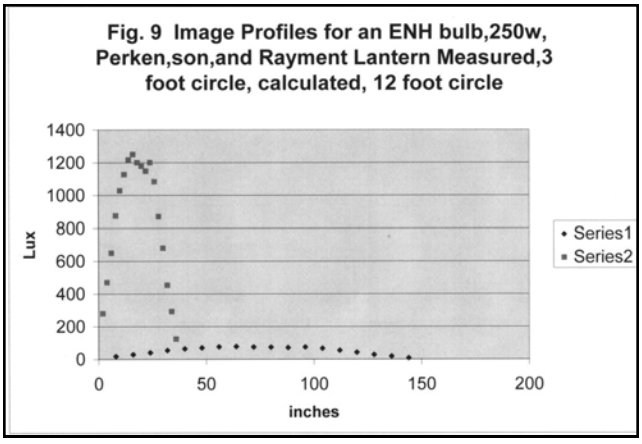
The use of the ENH and the ENH-5 bulbs in magic lanterns was pioneered by Jack Judson[14], and they been retrofitted to a number of lanterns owned by society members. Not listed in Table 1, the ENH-5 is a 125 volt rather than a 120 volt bulb, with a lifetime of 175 hours. It has the same specifications as the ENH bulb, but since it is intended for 125 volts, it should last considerably longer when run at 120 volts, probably having a lifetime of 262 to 336 hours (see technical note 1) with about 87% of the light. The ENH bulb comes in two varieties, one with a faceted the other with a smooth reflector. The smooth is desired for lantern work. It should be noted that the complete Judson retrofit package includes a cooling fan and "notch filter" that effectively removes both IR and UV radiation.

In using MR-16 style bulbs in multi-projector shows, or with a bi- or triunial magic lantern, it is desirable to match the color rendition of the bulbs. This may be done by placing a number of them on the platen of an overhead projector and noting the appearance of the reflector when the overhead projector is running. Those that look alike will render the same color rendition when used in the intended slide projector or lantern. A light box also can be used to sort bulbs, but the somewhat parallel illumination of the overhead projector is better.

In **Fig. 8**, an illumination profile is shown for an ENH bulb installed in a Perken, Son, and Rayment lantern. The bulb




holder and socket were removed from a junked Carousel projector and gave a clear aperture of 1.25 inches, the bulb reflector having a total effective diameter of 1.65 inches. Note the high levels of screen illumination achieved and also the extreme fall off of illumination level at the edge of the profile and extending into the illuminated profile of about 17%. In **Fig. 9** that same profile is given, scaled to a distance of a 12 foot circle. Note the illumination level is quite high, even with this large size image, and is close to 4 foot candles. Of the three bulbs studied, the ENH delivered the most lumens to the screen. However, more is not necessarily better, as we will see when slide conservation is discussed. Quartz-halogen bulbs require careful handling. Do not handle them with the fingers, but instead use a towel, gloves, or the plastic wrapper furnished with the bulb. Oil from the fingers will cause premature failure, Wipe the bulb with alcohol if accidently mishandled.




**DEK Bulb**

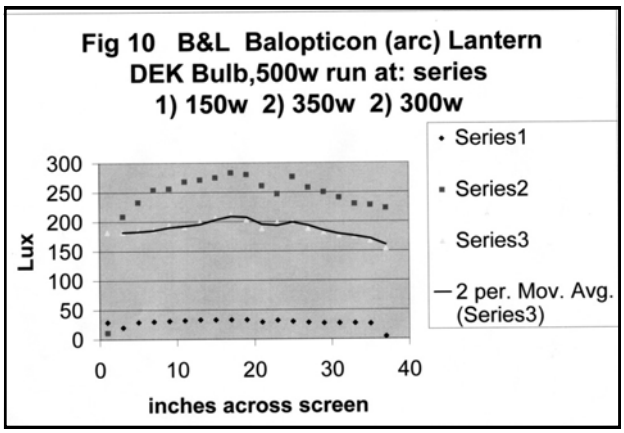
A bulb which I feel makes an interesting candidate for a magic lantern retrofit is the 500 watt DEK bulb. Formerly used in certain models of Carousel projectors, it is not a quartz–halogen bulb and thus can be run at lower wattages with correspondingly lower light output and longer life without fear of premature or unpredictable failure. It is

**Table 2. Projection bulbs with MR-16 reflectors (wrap around mirrors) and GY5.3 bases, run at rated voltages.**

| Bulb | Volts | Watts | °K | Lumens† | Screen lumens | % | Applica-tion | Life (hrs) |
|---|---|---|---|---|---|---|---|---|
| ENH | 120 | 250 | 3250 | 7335 | 340 | 4.6 | SP | 175 |
| ENH spot | 120 | 250 | 3250 | 7335 | 340 | 4.6 | SP | 175 |
| ENH-5 | 125 | 250 | 3250 | 7335 | 350 | 4.6 | OP | 175 |
| ENG | 120 | 300 | 3450 | 10787 | 690 | 6.4 | P | 15 |
| ELH | 120 | 300 | 3350 | 9725 | 525 | 5.3 | OP | 35 |
| EXR | 82 | 300 | 3350 | 9412 | 925 | 9.8 | SP | 35 |

† This work, Eq. 1. P = projector, SP = slide projector, OP = overhead projector
Sources: Interlight (online) and Osram-Sylvania catalog.

somewhat expensive however. In **Fig. 10**, illumination profiles are presented for this bulb used in conjunction with a B and L Model B Balopticon (arc) projector and run at 150, 300, and 350 watts. I believe that the profiles exhibit sufficiently even illumination, and the wide range of possible illumination levels available with this bulb are a positive feature. At 500 watts, 346 screen lumens are predicted. This would give about 4 foot-candles in a 10 foot circle and 3 foot-candles in a 12 foot circle. The ratio of the calculated value of lumens from color temperature (Eq.1) and that experimentally determined for this bulb gives a ratio of 0.87 and indicates that the "proximity mirror" is efficient in directing most of the light towards the condenser lenses. How efficiently the condenser can use this light is another matter. In the case of the ENH bulb, a rough estimate of the light directed toward the condenser system is about 75%, and the condenser receives much of it.




**BLC Bulb**

This is only a 30 watt bulb, but I recommend it highly for show practice **AND** small groups, say under 50 or so, and maybe even more. Key to success is **a dark room and a short period of dark adaption. Slide conservation concerns recommend its use.** In **Table 3**, the characteristic of the 4 bulbs are compared among themselves and to the limelight.

Inspection of **Table 2** illustrates first and foremost that very little of the available light reaches the screen and that the situation did not improve over the limelight era of the 19th century in the 20th. There is also a real reduction in bulb life with "brighter" i.e. higher lumens per watt bulbs.

I have used the interchangeable ESR at 100 watts and the 200w FEV bulbs for many years with completely satisfactory results. If you give shows in large halls, then one of the bulbs listed in **Table 2** might be a good choice, such as the ENH. Since the three above mentioned bulbs are quartz–halogen bulbs, it is not recommended that they be run at voltages less that those specified by the manufacturer, although Kodak did furnish a" high" and a "low" light setting with many of their Ektagraphic slide projectors with the "high" setting giving about 1.4 x light and about 1/3 to1/2 the bulb life. If you usually give shows to small audiences, but occasionally entertain large ones, then the DEK bulb deserves consideration, as this bulb can be run at lower voltages without fear of premature failure. Also, running a bulb at a lower wattage (color temperature) reduces both the IR (heat) and UV radiation. Of course it is always possible to rig a lantern to accept more than one type of bulb.

**Table 3. A comparison of the illumination characteristics of the bulbs used in this study, along with the limelight.**

| Bulb | Watts run | Lumens | Lantern | Lumens on screen | % | Life (hrs) |
|---|---|---|---|---|---|---|
| Limelight | —- | 3000-4000 | C | 105-140 | 3.5 | —- |
| ENH | 250 | 7335 | A | 452 | 6.2 | 175 |
| FEV 200W | 200 | 5500 | A | 199 | 3.6 | 50 |
| FEV | 200 | 5500 | B | 92 | 1.7 | 50 |
| FEV | 200 | 5500 | D | 127 wo/ mirror | 2.3 | 50 |
| FEV | 200 | 5500 | D | 213 w/mirror | 3.9 | 50 |
| DEK 500W | 500 | 14500* | E | 362 | 2.5 | 25 |
| DEK* | 150 | 717 | C | 20 | 2.8 | 10k+ |
| DEK | 300 | 4451 | C | 121 | 2.7 | 542 |
| DEK | 350 | 6019 | C | 173 | 2.9 | 220 |
| DEK 26 | 500 | 14500 | C | 391** | | |
| BLC | 30 | 299 | B | 6.7 | 2.4 | 50 |

Lanterns: A = Perken, Son, and Rayment biunial (lime light), B = Brenkert Model 01 biunial (Incandescent), C = Model B Balopticon (carbon arc), D= Science Lantern by Griffin (Incandescent), E = 35mm Carousel, model 650, used DEK bulb.

* calculated lumens from Eq. 1. ** Screen lumens at 500W estimated from the average percentage at lower wattage.

**Slide conservation concerns:** We have all observed that colors exposed to sunlight will fade. The "no trespassing" signs the author put up a number of years ago now have white letters against a black background instead of the original red. Albert Einstein postulated that the first step in any photochemical reaction such as sunlight fading is the absorption of one quantum, the fundamental "unit" of light for each molecule undergoing reaction. The result of this absorption is either the breaking of a chemical bond or the formation of a higher electronic energy state of the molecule known as an "activated complex." An activated complex has a very short lifetime, but if it collides with another reactant molecule before it decays to emit a photon of light (florescence), it can initiate a chemical reaction. For photochemical reactions occurring in gaseous or liquid phases, where collisions between molecules are frequent, activated complex formation is important. We however are concerned with solid state reactions and the breaking of chemical bonds by light is the effect we must consider.

The energy per photon or a specified number of photons is given by a simple expression consisting of a constant divided by the wavelength, the value of the constant depending on the units employed. Since chemists generally work in thermal energy units, calories or kilocalories and molar quantities, radiant energy is expressed in Kcal/ mole, a unit appropriately called the Einstein. (A mole is 6.023 x 10 exp 23 of anything but usually refers to atoms or molecules). Einstein values range from 95.5 kcal/mole for UV light at 300nm ("nm" refers to the wavelength of light in nanometers) to 40.84 for red at 700nm. At 600nm (yellow orange) the value of the Einstein is 47.65 which is high enough to break moderately strong chemical bonds. **The important thing to observe is that photon energy increases as wavelength decreases**; hence the importance of filtering out UV radiation. **However, visible light also can break chemical bonds.**

With respect to IR or heat radiation the problem of photo initiation is confounded with overall heating. The author has seen 7-watt incandescent walkway lights sublimate snow when positioned perhaps a foot from snow cover. A noticeable depression was formed after an exposure of perhaps two weeks. Chemical reaction rates increase with

increasing temperature, with a chemist's rule of thumb" being that a 10 centigrade temperature rise doubles reaction rate. It can be much higher or lower however. If a degradation reaction involves several competing chemical reactions or various steps all of which have widely different activation energies, accelerated high temperature testing may not give results which can be extrapolated to low temperature use conditions. Such a condition is known to exist with natural rubber.

At this point it also should be noted that every photon absorbed does not necessarily lead to a chemical reaction. The ratio between the two is known as the **quantum yield.** In studying photochemical reactions chemists use light of nearly the same wavelength (monochromatic light ideally) and measure the total light output energy by its conversion to heat traditionally employing a thermopile.

**Visible light concerns:** As was mentioned earlier visible light can break chemical bonds. Current museum practice for "light sensitive" exhibits such as watercolors, prints, dyed leather, and textiles dictate that these materials should be exhibited with a illumination level of no more than 5 fc (54 lux) over 8 hours. Less sensitive materials such as tempera and oil paintings, painted wood, horn, undyed leather, and oriental lacquer can tolerate up to 15 fc for 8 hours. **Light damage is cumulative,** so such measures as limiting exhibition times and the use motion sensor or timer activated lighting is encourage.

With respect to lantern slides, data from **Table 3** suggests that an ENH bulb can deliver 452 lumens to the screen through a 3 inch slide mask. Assuming 20-30% of the light is lost in the projection lens, the slide is exposed to 565-646 lumens which gives a whopping 11,507 to 13,157 foot candles. Assuming 50% of the light is absorbed, **one minute of projection is equal in light history (foot candle minutes) to about 2-3 days of museum 8 hour day exposure at 5 fc.** The 35mm slide case is about 3 times worse if we use the modest value of screen illumination for the model 640 Carousel given in table 3. The basic assumption that a 2600x increase in illumination level is directly proportional to an exposure to 5 fc over 16 to 24 hours is probably not correct, but it is a start. All of this suggests that that lantern slides should not be projected for much over one minute per week. Probably this restriction would not inconvenience most society members, but it is a good argument for using low wattage bulbs. If slides are to be projected frequently, copies should be made and these projected. **There is an argument for not projecting original slides at all!**

**UV light concerns:** Due to its high photon energy, UV light is considered very detrimental. UV light intensity is not measured in foot candles, but in watts or microwatts (um) per unit area, typically in square centimeters ( sq. cm) UV light is not visible to the human eye and hence the photometric units of foot candles for intensity have no meaning. It is possible to convert foot-candles to watts per square foot by multiplication by a suitable constant, but the constant depends upon the sum of all the spectrial component intensities in the light source and, in the author's opinion, such a conversion would serve no purpose.

Comparing foot-candles with watts per square foot is an apple to oranges comparison. Unfortunately some in the conservation community have used this ratio without proper qualification of units. We can say the ratio of boys to girls is 1.2 to 1 but it must be qualified. If we are referring to height then the qualifier is length, if weight then the qualifier is weight etc. Note that the units cancel, say inches for height and pounds or perhaps stone for weight to yield a dimensionless ratio but we still must qualify to what we are measuring There has been a trend to express the ratio of UV radiation in microwatts per square foot and that of visible light in foot –candles or *lumens per square foot*. Canceling the units of square feet gives a ratio of microwatts per lumen

This ratio **does not** express illumination intensity ratios as written unless qualified by "per square foot". Instead, it compares the power ratio of the *light source* in the defined spectrum regions which is not what is of concern. Illumination *intensity* is what is important. Thanks to the misunderstood UV/visible ratio, some writers have used lumens when foot-candles are intended, which further confuses the issue. In this author's opinion, the two should be kept separate and have separate specification, light in foot candles and UV in microwatts per square centimeters would be satisfactory since the methods of control are different, light levels by lamp wattage and placement, UV by filters. In the past, at a light level of 5fc, a UV level of 0.4uw/sq.cm was thought acceptable. Recently the Canadian Conservation Institute has recommended that UV intensity levels should be 7.5 times lower.

In the case of the Griffin Science lantern, direct measurement at the gate was possible, and a value of 365uw/sq.cm was obtained with the 200w FEV bulb. This is about 900 times more exposure than the 0.4 uw/sq.cm recommended for light sensitive objects. With a level 7.5 times lower the value jumps to ca. 6800x. Thus, one minute of exposure has the same dosage as close to 5 (8 hr) days of museum exposure at 0.4uw/sq.cm. Using the new suggested lower level the time jumps to ca. 36 days. The measurements were made with a GeneralUV513AB digital UV meter sensitive to UVA (400-320nm) and UVB (320-280nm) When hand colored photographic and transfer slides were placed in the gate, the absorption ranged from 20 to 76%, depending upon image density. It should be again mentioned that only radiation absorbed has the chance to initiate a photochemical reaction. Assuming an average of 50% absorption will reduce the above equivalent museum exposure days by half. Once again these are very rough estimates. It should be noted that glass cuts off most UV radiation below about 330nm, so the condenser lenses

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also important to note that with incandescent bulbs UV output is proportional to color temperature thus by keeping the color temperature of the lamp as low as practical will minimize UV light output

**Filters for UV and IR radiation control:** All filters fall into two general classes, absorbing and reflecting. The oldest of these are the absorbing filters and these obey the Bouguer-Lambert law:

Eq. 7) $I = I_0 e$ (exp)-ax

I= intensity of light leaving the filter after traversing the filter thickness, x. $I_0$ = intensity of light entering filter (x=0). a = absorption or extinction coefficient

What is important to note is that an absorption filter only removes a fraction of the incident radiation. Thus an absorption filter that removes say 50% of a given wavelength at unity thickness (x=1) will reduce the light to 25% by doubling the thickness (x=2). Increasing the thickness to 4 times the unity thickness (x=4) reduce the light level to 12.5% etc. Thus, absorption filters can never truly achieve zero light levels; but the level can be negligible. IR absorbing filters of standard thickness made of special IR absorbing glass, such as Schott KG-1, transmit over 90% of the visible light and gradually reduce the transmission of IR. With this glass the transmission is 50% at 700 nm and falls to 1% at about 950nm. Schott KG-3 glass transmits only 80% of the visible but at 800 nm transmission falls to a few percent. Typically these glasses have a maximum operating temperature of 250C, but specially tempered versions are useful up to 300 C. As was mentioned earlier these filters **must be cooled.**

UV absorbing filters are available such as Schott glass colorless sharp-cutoff glasses GG-385 or GG-395, Melles Griot product numbers 03FCG049 and 03FCG055 respectively. An inexpensive alternative if heat buildup can be controlled is the 3mm thick 98% UV absorbing Plexiglas available from Gaylord Bros., PO box 4901, Syracuse, NY, 13221-4901 (1-800-448-6160), www.gaylord.com. An 8x10 sheet, cat. # UVP810 costs about $10.00 plus shipping. This material is easily cut with a fine tooth band saw blade or using a jig-saw. The author recently installed this material in the vacant shutter slot of the previously mentioned Perkin, Son and Rayment lantern just before the slide carrier and measured heat build up using an IR thermometer. With a 100W ESR bulb, the temperature rose at 0.35 degrees F per min for about 80 minutes and then seemed to level off at ca. 115 F. With a 200W FEV bulb, the heating rate was about double, and the temperature seemed to level off at about 130 F after 90 min. This latter figure is well below the glass transition temperature of 195 F, which is the point where the plastic changes from a glassy to a rubbery material. **All plastic UV filters degrade with time.** Just how long this filter will still be effective is unknown, and certainly any filter which turns yellow should be replaced.

The other class of filters is an interference filter. These achieve wavelength selection by interference of light and employ carefully controlled layers of alternating high and low refractive index materials. They are expensive. One of best choices I feel would be the Hot-Cold "permicolor" mirrors available from Rosco labs, 50 harbor View Labs, Stamford CT, 06902 (904-683-5553). The cat. # 5.25-3800 permicolor hot cold mirror is as the catalogue number suggests 5.25 inches in diameter and is currently priced at $67.75. With care it could probably be cut into two 2.5 inch circles, which when mounted fairly close to the lamp would cover acceptance angle of the condenser. These mirrors are also available in larger sizes. The Rosco permicolor hot-cold mirrors pass about 80% of the visible light between 400 and 750nm while rejecting both UV and IR radiation. Once again a cooling fan should be installed.

**How much Light is "enough"?** Unfortunately there is no simple answer to this question. The "lumens on the screen" entry in **Table 2** can be used as a rough guide by dividing the intended screen *area* into the listed values to yield the average foot-candles delivered to the screen. In the author's experience, with a few minutes of dark adaptation slides can be adequately projected with only 0.2-0.3 foot candles on the screen. This is a far cry from the recommendation by Johnson of 4-5 foot-candles as an acceptable level.[16] The author has given lantern shows in an outdoor environment with a screen illumination of about 1 foot-candle and recently gave a show at the Dittrick Medical Museum located in Cleveland, Ohio using 30 watt BLC bulbs. About 50 people were present, the room was dark, and the slides were projected to a diameter of a 4 foot circle. The light level on the screen with no slide in place was estimated at 0.53 foot- candles. Unfortunately it is difficult to achieve in this day and age a truly dark environment in a public hall. Lights on stair treads, exit light signs, etc. can be real problems. One is either faced with covering over or switching off these annoyances and possibly violating fire and building code laws, or projecting at a higher light level or if that for some reason is not possible, reducing the screen area.

**The color photograph problem and further slide conservation concerns**

Our color photographic heritage is gradually fading away. With respect to color 35 mm slides, the situation is rather grim, and since these are now part of our magic lantern heritage, the problem should be mentioned. With the demise of Kodachrome, Kodak lost probably what was their best product with respect to ***dark storage stability,*** with no detectable image degradation occurring for at least 50 years (process K-14) under proper storage conditions. Unfortunately Kodachrome has the poorest ***projection stability*** of any Kodak slide film, based on data gathered prior to about 1992. The two are not necessarily related,

and many short projections are more harmful than one long one. Kodak has been traditionally reticent to release fading data on their color film products. In 1975, they released the following information on their color transparency films. *Kodachrome*, dark stability, 50+ years (process K-14), projection stability, 250-500 times, 15 seconds each, with totals of about 1 to 2 hours. *Ektachrome-X* (process E-4), dark stability 10-20 years, projection stability 375-1000 15-second projections, with totals of about 1.25 to 3 hours. Willhelm, in his book titled *The Permanence and Care of Color Photographs* (Preservation Publishing Co., 1993), recommended accumulated projection times of no more than 5 hours for Fujichrome, 2.5 hours for Ektachrome, 2 hours for Agfachrome, and 1hour for Kodachrome. The Kodak cardboard "Ready Mounts" used by both the former Kodak processing stations and their offspring Kodalux are not harmful to color slides. Plastic mounts are probably OK and glass mounts keep finger prints off the film but **do not influence either dark or projection stability**. This last point should be noted by lantern collectors who have glass mounted photographic hand colored slides

It is common practice to store 35mm slides in a notebook in so called "slide pages." Polypropylene notebook pages are the best. Stay away from PVC (Vinyl) and low density polyethylene. Slide storage boxes as supplied by Kodak or Kodalux appear to be satisfactory, and plastic boxes are fine. If the latter are translucent, be sure to store them in the dark. Valuable slides should be duplicated, preferably on *Fujichrome Duplicating Film*, if they are to be exhibited extensively. The same goes for any slide that shows evidence of fading or staining, or if the original is on comparatively unstable films such as pre-1978 Ektachrome, pre-1989 Agfachrome, 3M Scotch Chrome, Polaroid presentation Chrome and pre-1984 Eastman color motion picture print film. This latter film is very unstable and was used extensively for the mass production of slides sold at tourist sites. The author has a number of 30 to 40 year old "tourist slides" which have faded quite badly despite having been projected only a few times.

Any 35nmm slides should be stored in the dark at temperatures below 75° F and at a relative humidity kept as low as possible, and never above 65-70% for prolonged periods, as this will encourage fungus growth. A final warning: Do not leave 35mm slides on a light box or even spread out on a desk for prolonged periods. Exposing slides to as little as 100 foot-candles in time will be detrimental. The light on a slide in an Ektagraphic Carousel projector delivering 1000 lumens to the screen is 107,526 foot-candles! Thus Kodak in the past has recommended projection times of no more than one minute. These same general guidelines are probably applicable to lantern slides as well. With respect to lantern slides, my own observations are that with painted slides, the dark storage stability seems to be excellent, the chief problem being adhesion failure of the paint to the glass and parts of the image flaking off. **With respect to projection stability, no data exist**, and probably the best plan is to follow the general guidelines used by museums in the exhibition of "light sensitive" materials discussed previously.

Unfortunately there is quite different emotional response to viewing a copy of a work of art versus the original. Typically a museum will exhibit rare prints for perhaps a few months and the next exhibition might be in 20 years! I feel a middle course is best for now and that we have to make the decision to exhibit originals rarely, or copies often. It is a choice that, in my opinion, has to be made.

It is not generally recognized that bare florescent lights have a significant UV component at 365um and also at other wavelengths, so that in the exhibition of lantern slides on a light box illuminated by florescent light the light box should first be overlaid first with glass and then with a sheet of suitable UV absorbing material. Again, as with 35mm slides, light exposure at any wavelength should be minimized.

And now**,** a final rule:

**Keep the lantern light as low as possible!**
Otherwise our magic lantern slide heritage may just fade into oblivion.

**Technical Note #1**

**Estimation of the life of an ENH-5 125volt lamp at 120volts**

Using eq.3 this bulb should put out about 87% less light. Using eq.2 and a (b) value of 4.7 a life of 336 hours is predicted. The value of (b) chosen is an average for the Sylvania quartz- halogen bulbs discussed with respect to eq.2 Kenny and Schmidt (15) give relative light output values and bulb life times for the ENH bulb referred to a 300 watt ELH bulb run at 120volts. This latter is assumed to run at 100% of (X). The ENH bulb (when run at 120 volts) will give 65% (X) of the total light of the ELH and has a life of 175hours. When run at reduced voltage it gives 50% but has a life of 330 hours. We have the data to generate a value of (b) in eq.2 if we can compute the lumens per watt at the lower light level. First we compute for the ENH bulb the total light using eq1 and this value is listed in table 1.and in turn use it to compute (X) obtaining a value of 11,569 lumens. This gives a value at 50% luminous output of 5784 lumens or nearly 80% of the 120volt value. In the case of the DEK bulb a reduction of light output of 80% was achieved at 90% full voltage so applying this datum to the ENH case a value of 225 watts is obtained. Calculating the lumens per watt in this case and using eq2 a (b) value of 5.25 is obtained.

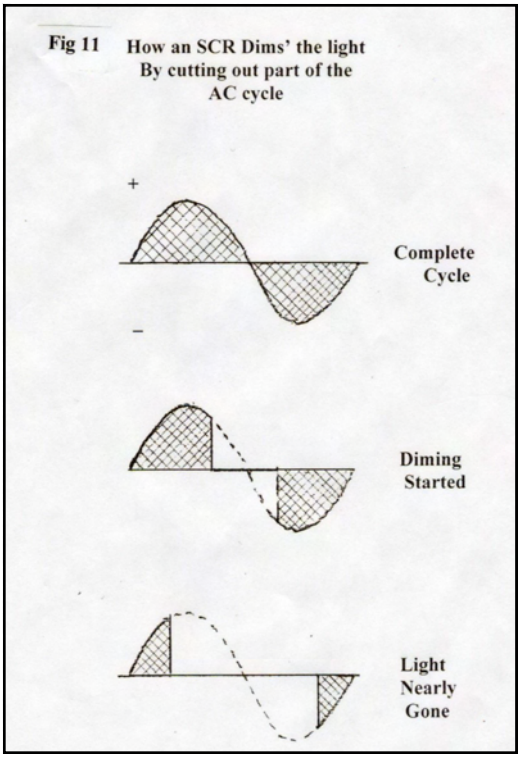
Considering the 125 volt ENH-5 bulb the use of eq.4 enables the current to be calculated and hence the wattage, 234w at 120 volts versus 250w at 125 volts.

Using eq. 3 gives the total luminous output at 120 volts of 6282 lumens or 26.86 lumens per watt. Reference to Eq. 2 gives a life of 262 hours or about 1.5X greater. All these involved calculations indicates definitely a longer life, probably 1.5 to 1.9X at 120 versus
125 volts

**Technical Note #2**

**The action of an SCR dimmer**

Unlike a variable auto transformer such as a Variac or a rheostat an SCR dimmer does not reduce the amplitude of the sine wave or voltage uniformly of the incoming alternating current (AC).With these devices the sine wave characteristic of the current is preserved. An SCR however acts like a gate and as the lamp is dimmed less and less of the sine wave character is preserved until it finally disappears altogether and the light goes out. The sine wave is literally cut away. The action of an SCR is shown in **Fig. 11** for a single AC cycle. Due to the peculiar nature of the waveform being applied to the lamp **one cannot make a meaningful measure of the voltage at the lamp terminals.** AC voltmeters generally measure what is known as the RMS (root mean square) value of the applied voltage and are good only on true AC circuits whose waveforms are sine waves. It should be noted that a measurement of the wattage required to bring a lamp to the same light output (lumens per watt) is the same whether a Variac or an SCR is used. With the Variac the watt meter was placed in the circuit before the lamp, with the SCR, before the SCR.

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castle@magiclanterns.org , www.magiclanterns.org

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**Joe Kember, John Plunkett, and Jill A. Sullivan, eds. 2012. *Popular Exhibitions, Science and Showmanship, 1840-1910.* Pickering and Chatto, London. ISBN 978-1-84893-306-4. 304 pages, illustrated. £60/$99.**

This book presents scholarship by historians of science, cinema historians, and others interested in cultural history. The focus is entirely on British shows and spectacles in the Victorian Era. The types of shows discussed include magic lantern shows, panoramas, scientific lectures, magic shows, the Great Exhibition of 1851, exhibitions of exotic people, freak shows, the "Talking Fish" (actually a seal), and public unwrappings of ancient Egyptian mummies, among others. All of this material is interesting, and even chapters that make no mention of magic lanterns provide interesting context for locating magic lantern shows in the broader world of entertainment and education. Much of the scholarship in the book makes use of previously neglected sources, including newspapers and other periodicals, broadsides, guidebooks, and other sorts of ephemera. The book is aimed mainly at serious scholars rather than general readers. It is expensive, so readers of the *Gazette* may want to borrow a copy through interlibrary loan.

References to magic lanterns turn up in a number of chapters, and several chapters will be of particularly interest to magic lantern scholars and collectors. Perhaps the most relevant is a chapter by Martin Hewitt entitled "Beyond Scientific Spectacle: Image and Word in Nineteenth-Century Popular Lecturing." Hewitt discusses the use of magic lanterns in popular lectures, mostly in the early Victorian Era (1850-1870). However, one of his main points is that the use of magic lantern slides in lectures has been overemphasized, although it is not entirely clear which scholars are responsible for this overemphasis. Using quantitative data for lectures given at venues such as Mechanic's Institutes and Working Men's Clubs, he estimates that only about a quarter of all lectures involved the use of lantern slides. He argues that, at least in the mid-19$^{th}$ century, many lecturers lacked the expertise to manipulate limelight lanterns, and slides were expensive and hard to obtain. One wonders whether the same would be true in the last quarter of the 19$^{th}$ century, when mass-produced photographic slides were readily available.

For a relatively short chapter, Hewitt's contribution is packed with new information. Many previously unknown lecturers are mentioned, often identified from newspaper announcements. I was often left wishing for more detail about these individuals, although it seems likely that specific information about their lives and careers will be hard to find. In addition to his discussion of lantern slides, the author describes other types of illustrations used in lectures, including blackboard drawings, pre-drawn sketches, paintings, etc. He also emphasizes the frequent praise in the periodical press for lecturers who were able to "paint a picture in words" without using actual illustrations. Some accounts even described the skills of lecturers with magic lantern metaphors. For example, a description of a lecture by George Gilfillan reported that "picture followed picture, clear and vivid as on the screen of a magic lantern" (p. 89). Another lecturer was criticized for being too extravagant with his verbal pictures, resulting in a lecture that was "too phantasmagoric, the dissolving views flitted too rapidly past to be graven on the mind and memory" (p. 89). Other descriptions were more subtle, but nevertheless bring to mind magic lantern slides. One clergyman who lectured in the 1840s and 1850s was said to have a mind "crowded with images…With these he lit up the subjects of his speech, flashing upon abstruse points the ray of an illustration" (pp. 90-91).

In the concluding section of his chapter, Hewitt argues that popular lecture culture went into decline in the late 1890s and especially after World War I. Some commentators complained that lecturers had moved from illustrating their lectures to lecturing on their illustrations, converting lectures into mere magic lantern shows. Hewitt also points to the proliferation of "lecture" scripts for lantern slides that could be purchased by anyone, turning every amateur showman into a lecturer. I am not completely convinced that either lecturing or the use of lantern slides experienced as dramatic a decline as Hewitt argues, and it would be interesting to compare trends in Britain and the United States. My own research on lectures in Brooklyn, New York, indicates that there was a thriving lecture culture from the 1890s until 1910 or later, and the number of illustrated lectures actually increased in the late 1890s. Terry Borton's research on the Chautauqua lecture circuit (coming in a future issue of the *Gazette*) also reveals a lively lecture scene well into the 20$^{th}$ century.

Another chapter of great interest to magic lantern scholars and collectors is one by John Plunkett and Jill A. Sullivan, both of whom are involved in a project at the University of Exeter on "Moving and Projected Image Entertainment in the South-West [of England], 1820-1914." Plunkett also is working on a book on optical entertainments and has previously written on connections between literature and magic lanterns. Their chapter, entitled "Fetes, Bazaars and Conversaziones: Science, Entertainment and Local Civic Elites," seeks to move beyond familiar urban show venues such as the Royal Polytechnic to smaller provincial venues. They discuss the use of optical devices such as magic lanterns, stereoscopes, and oxy-hydrogen microscopes in public shows and demonstrations in venues such as charity bazaars, fairs, and informal discussion groups. They focus their analysis on two cities in Devon, Plymouth and Exeter. By searching local provincial newspapers, the authors are able to provide quantitative estimates of the numbers of such presentations and the types of instruments that were used. A table in the chapter summarizes 18 events, mostly for charity fundraising, in Plymouth from 1861 through 1865. A few of these involved use of magic lanterns, and there were a number of "limelight demonstrations," all given by a Mr. Hearder. Demonstrations of

oxy-hydrogen microscopes, regular microscopes, revolving stereoscopes, and other philosophical toys and instruments were common as well. In Exeter, small-scale events such as church fundraisers often featured stand-alone magic lantern shows, displays of dissolving views, or demonstrations of one or more kinds of philosophical toys, such as the zoetrope. Special light effects involving limelight, electric lights, or polarized light also were popular.

This chapter focuses attention on two neglected aspects of magic lantern shows and other optical displays—the importance of small, local venues, and the role of local "gentlemen of science" in providing such entertainments. These might be local opticians or instrument makers, or others with a strong interest in science, but generally not professional scientists. Here we see parallels with developments in the United States. The first stereopticon exhibitions in the 1860s, for example, were mounted in local venues like town halls, using an instrument owned by John Fallon, a textile dye chemist generally recognized in his community as a sort of local "Mr. Science." The exhibitions themselves involved a number of amateur showmen and lecturers who earned their livings as merchants, business managers, or clergymen. It was only in the 1870s that professional lantern lecturers proliferated in the United States.

For readers of the *Gazette* whose interests extend beyond magic lanterns to other entertainments, such as panoramas, there are a number of additional chapters with valuable material. Bernard Lightman, a historian of science, has a chapter entitled "Spectacle in Leicester Square: James Wyld's Great Globe, 1851-1861." This chapter is very similar to an article by Lightman recently published in the journal *Endeavor*. It describes an unusual attraction that appeared in London at the time of the Great Exhibition of 1851 and lasted ten years. This was a giant globe that contained a relief model of the earth on the inside, along with exhibit halls and lecture rooms. Over the years, the proprietor, James Wyld, added models of the Arctic regions, panoramas, dioramas, and other attractions. All of these features were in competition with all manner of other Leicester Square entertainments, including freak shows, bearded ladies, panoramas, dioramas, wax works, and museum galleries. Another piece that focuses on visual entertainment is a somewhat awkwardly titled chapter by Verity Hunt, "Narrativizing 'The World's Show': The Great Exhibition, Panoramic Views and Print Supplements." The chapter explores the panoramic nature of the Crystal Palace Exhibition of 1851, along with panoramic views of the exhibition and printed ephemera such as fold-out guides, pamphlets, and representations in the periodical press. The chapter also explores the increasing popularity of actual panoramas in the period around 1851.—**The Editor**.

## STATE OF SLEEPING.

In this, we are divested of the locomotive faculty; and our limbs but imperfectly execute a few semi-motions, which are merely the involuntary results of sensation (9).

Our senses become incapable of conveying any perception of external objects.

The body, so obedient to our call when in the waking state, now refuses its co-operation.

There passes within us a sort of curious scene, of which most frequently we are rather spectators than performers; and yet, almost always deeply affected by it. Sometimes, it may be compared to a magic-lanthorn: a variety of images file off in succession, without order or connexion; they are pleasant or unpleasant to us, and occasionally appear so hideous as to produce grief and terror: invisible interlocutors speak, whom we only hear, without seeing. At other times, it is a complete event: animals, human beings, fantastical ones, appear to act in our presence; we converse with them, and feel as somehow participating in the imaginary occurrence. But this is much less any positive action, originating with ourselves, than a condition in which we experience very diversified sensations; and any attempt at real action is, almost invariably, accompanied with a sense of unconquerable difficulty in the execution.

Francis Corbaux. *On the Sentient Faculty, and Principles of Human Magnetism,* translated from the French of Count de Redern. Sherwood, Neely, and Jones, London, 1819, pp. 36-37.

CLOSING BALANCE PRIOR ANNUAL REPORT

| | | |
|---|---|---|
| Operating Balance January 1, 2012 | $ 13,900.79 | |
| Research Award Fund January 1, 2012 | $ 1,095.59 | |
| Total Cash Balance January 1, 2012 | | $ 14,996.38 |

INCOME

| | | |
|---|---|---|
| Membership Dues - Note 1 | 5527.35 | |
| Gazette Sales - Hard Copy | 30.70 | |
| Electronic Files Sales-Gazette and Index CD/DVD | 0.00 | |
| Interest | 0.51 | |
| Subtotal Income | | $ 5,558.56 |

2012 CONVENTION

| | | |
|---|---|---|
| Registration, Sales Tables, and Visitor Income | $ 6,450.02 | |
| Auction Proceeds net 10% of Auction Gross Sales | $ 432.70 | |
| Museum Dinner | $ 69.56 | |
| Meeting Room Expenses/Food | $ (4,608.58) | |
| Museum Show | $ (1,713.61) | |
| Registration and Welcome Packet Printing/Supplies | $ (239.58) | |
| Subtotal Convention - Note 2 | | $ 390.51 |

OPERATING EXPENSES

| | | | |
|---|---|---|---|
| Administration | | | |
| Postage - Note 3 | $ (81.38) | | |
| Supplies | $ - | | |
| Bank Service Charges - Note 4 | $ 10.00 | | |
| Subtotal Administration | | $ | (71.38) |
| Electronic Files - Gazette and Index | | | |
| CD/DVD Electronic File Postage | $ - | | |
| CD/DVD Electronic File Supplies | $ - | | |
| Total Electronic files - Gazette and Index | | $ | - |

| | | | | |
|---|---|---|---|---|
| Membership Directory - Spring 2012 | | | | |
| | Postage | $ (166.48) | | |
| | Printing | $ (285.18) | | |
| | Supplies | $ (5.42) | | |
| | Subtotal Directory | | $ (457.08) | |
| Gazette - 5 Issues | | | | |
| | Postage | $ (1,376.29) | | |
| | Printing | $ (1,520.27) | | |
| | Supplies | $ (80.88) | | |
| | Subtotal Gazette | | $(2,977.44) | |
| Membership | | | | |
| | Awards/Memorials - Note 5 | $ (512.20) | | |
| | New Member Welcome Postage | $ (24.20) | | |
| | New Member Welcome Supplies | $ - | | |
| | Renewal Member Postage | $ (87.60) | | |
| | Renewal Member Printing | $ (71.52) | | |
| | Renewal Member Supplies | $ - | | |
| | Subtotal Membership | | $ (695.52) | |
| Publicity | | | | |
| | MLS Flyer Printing | $ (272.69) | | |
| | MLS Flyer Postage | $ (10.85) | | |
| | Subtotal Publicity | | $ (283.54) | |
| Website | | | | |
| | Hosting Fees and URL Registration | $ (117.39) | | |
| | Subtotal Website | | $ (117.39) | |
| | Subtotal Operating Expenses | | | $ (4,602.35) |

| | |
|---|---|
| Total Balance December 31, 2012 - All Accounts | $ 16,343.10 |
| Research Award Fund held in Savings Account | $ 606.10 |
| Net Operating Balance December 31, 2012 | $ 15,737.00 |

NOTES

General: All funds held in traditional checking/savings accounts at Bank of America.

1. Dues Income listed above is Net Income and does not include $ 54.55 in PayPal service charges. 49 new/renewing members paid their membership via PayPal in this reporting period.
2. Does not include depost of ($ 275) for the History Museum paid in 2011. 2012 Convention as a whole netted profit of $ 115.51.
3. Administrative postage includes mailing hard copy e-pubs to members without email access.
4. Credit for an errant $10 bank service charge from 2011 that was credited back to account in 2012.
5. Includes $500 Research Fund Award.

*Respectfully submitted, Ron Easterday, Secretary/Treasurer, January 19, 2013*

The Research Page provides short summaries of scholarly research articles related to magic lantern history in a variety of disciplines. For a complete bibliography of research articles related to the magic lantern, visit the Zotero Magic Lantern Research Group at: http://www.zotero.org/groups/magic_lantern_research_group.

***The Magic Lantern Society Newsletter*, number 110 (December 2012) and *The New Magic Lantern Journal*, vol. 11, no. 3.**

As with the previous two issues of the publications of the Magic Lantern Society in Britain, which were summarized in the Fall issue of the *Gazette*, the latest issue of *The New Magic Lantern Journal* is imbedded within *The Magic Lantern Society Newsletter* (pp. 8-16), although both parts of the publication have interesting research articles. The main feature article in *The New Magic Lantern Journal* is a wonderful piece by Laurent Mannoni on "The Tour of the World by Magic Lantern. Eugene Danguy's Diaphorama" (pp. 8-13). The article describes the slides and optical part of a lantern recently acquired by the Cinémathèque Française that originally belonged to a lantern showman, Eugene Danguy (1831-1889). Danguy used a complicated three-lens lantern with lenses arranged horizontally, along with long wooden slides, each of which contained three separate images. Many of the slides not only produced dissolving effects, but also had moving elements controlled by pulleys, leavers, and cranks. The article is illustrated with superb color photographs of some very unusual slides, both hand-painted and hand-colored photographic slides. These are simply fabulous slides, nearly unique in their construction. Mannoni provides a very interesting overview of the career of this previously unknown magic lantern showman.

Another article by Sarah Dellmann, "To and From the Magic Lantern: Reappearing Photographic Images of the Netherlands in Various Media," describes the use of the same photographic images of Dutch people and scenery in different media. For example, one illustration shows two lantern slides of the same scene in Amsterdam; when these are placed side-by side, the slightly different angles of the photographs clearly show that they are two halves of a glass stereoview. Two other illustrations show the same view of a windmill, one on a glass lantern slide and the other on a cardboard stereoview. Images found on lantern slides also turn up on souvenir photographs and in guidebooks. The same images also crossed national borders, with photographs turning up as lantern slides in one country, stereoviews in another, and published guidebooks in a third country.

The *Newsletter* part of this issue contains a short article by Lester Smith on "The Slipping Slides of Carpenter & Westley, 24 Regent Street, London." The article describes how to identify motion slides from this manufacturer and includes color photographs of some exceptionally high-quality hand-painted slip slides, some with phantasmagoric images.

**Edwin Carels. 2012. From the ossuary: animation and the dance macabre. *Tijdschrisft voer Mediageshiedenis* 15:25-42.**

This article, by a Belgian scholar, published in English, in a Dutch media history journal, focuses on the image of the skeleton, particularly animated images, in media from magic lanterns to cinema. The first image shown in the article is a sketch by Christiaan Huygens from 1659 showing designs for moving lantern slides in which a skeleton moves around and even removes its own head. He links this early magic lantern image with the theme of the dance macabre in earlier art, especially the paintings of Hans Hobein. He then moves forward to consider the early Disney film, *Skeleton Dance*. This film, made in 1929 as the first installment of the *Silly Symphonies*, shows a row of skeletons dancing side-by-side in synchrony, and image probably derived more from zoetrope or praxinoscope strips than from lantern slides. Also discussed are Athanasius Kircher's use of skeleton images in his illustrations of magic lanterns in 1671 and Robertson's Phantasmagoria. He traces the influence of the phantasmagoria in later use of skeleton images in Joseph Plateau's phenakistoscope and the "dancing skeleton" choreutoscope" for the magic lantern. Robertson's influence also persisted in the early animated films of Emile Cohl, including one entitled *Fantasmagorie* (1908). Cohn made drawings in black ink on white paper, but used a photographic negative for projection, resulting in white line images on a black background, as in the original phantasmagoria shows. The main character, a puppet, has a skeleton-like appearance and at one point loses his head, as in Huygens's original concept for an animated lantern slide.

**Pat Millar. 2012. A collaborative legacy: Keith Jack's coloured lantern slides from the Ross Sea Party (1914-1917). *The Polar Journal* 2:427-443.**

This article focuses on six lantern slides from a group of 64 made by Keith Jack on Shackleton's expedition to Antarctica. The slides are currently in the State Library of Victoria in Melbourne, Australia. The slides were colored by a colorist from Alexander Gunn and Sons, a Melbourne lantern-slide manufacturer. The author gives a brief review of the history of Antarctic photography and the difficulties involved in such work. There also is a discussion of methods of coloring lantern slides and other photographs. Some early Arctic and Antarctic photographers actually used color photography, including Autochrome plates that were available from 1907, as well as a complex method of color photography developed by Paget. The author briefly discusses the importance of lantern-slide lectures by many of the leading explorers and photographers as a means of presenting results of their expeditions to the public. The article provides a detailed analysis of specific slides, along with a discussion of how they were made.

**Robert Dixon. 2006. Travelling mass-media circus: Frank Hurley's synchronized lecture entertainments. *Nineteenth Century Theatre and Film* 33:60-87.**

This article came out several years ago, but I just discovered it recently. It has a lot of material of interest to magic lantern scholars. Frank Hurley was an interesting character, an Australian explorer, traveler, and showman who participated in expeditions to Antarctica and made his own expedition to New Guinea. He made both still photos and movies of the expeditions and often lectured on his exploits with both lantern slides and moving pictures. The author credits Herbert Ponting as the inspiration for Hurley's career. Ponting was the first official photographer on an Antarctic expedition, accompanying Capt. Scott on the 1910-1913 British Antarctic Expedition. Not only did Ponting's photographs become the source for lantern slides in lectures delivered by Ponting and others, but he also took sets of slides along on the expedition and entertained the ship's crew with magic lantern shows. A photograph in the article shows him lecturing on Japan with a lantern aboard ship. Hurley himself was the official photographer on the Australian Antarctic Expedition in 1911, organized by Douglas Mawson. Mawson later presented illustrated lectures of his expedition, using Hurley's photographs, in Australia, England, Europe, and the United States.

The author emphasizes the multi-media nature of Mawson's, and later, Hurley's shows. These not only combined lantern slides with moving picture films, but also produced many tie-in items, including souvenir booklets, souvenir photos, books, newspaper articles illustrated with photos. Presentations involved both lectures and music, each carefully synchronized with the still or moving images on the screen. The tie-ins were a major feature of the marketing campaign designed to increase sales of tickets and books. In a presentation called *The Home of the Blizzard,* there was even a lantern slide showing the cover of a book by the same name, and books were sold at the shows. With the outbreak of the First World War, Hurley took war photographs, including Australian operations in Palestine. In London, he used some of these photographs to assemble the "largest picture in the world." Later he gave lantern-slide lectures using some of the same photographs, described as miniatures of the mural-sized photographs exhibited in London.

In 1918, Hurley obtained the Australian exhibition rights for films and lanterns slides from Antarctic expeditions of Scott, Mawson, and Shackleton, with 80-150 slides for each lecture. He rewrote the lectures originally given by the explorers themselves and developed his own multi-media shows. In the 1920s, Hurley traveled to Australian-ruled Papua New Guinea and returned with photographs and movies that he used in a very successful show called *Pearls and Savages*, which ran for many years. Many of the superb hand-colored lantern slides of New Guinea, as well as earlier lantern slides of the Antarctic, can now be seen online in the collection of the National Library of Australia.

**The Magic Lantern Society of the United States and Canada**

**Announces Its Second**

**$500 Student Essay Award**

The Magic Lantern Society of the United States and Canada is pleased announce its second Student Essay Award. The award has been created to invite the participation of young scholars, archivists and artists in research on the magic lantern. We welcome submissions related to the culture, practice, and study of the lantern, from the 1600s to the present, anywhere in the world, but especially in America, or Canada.

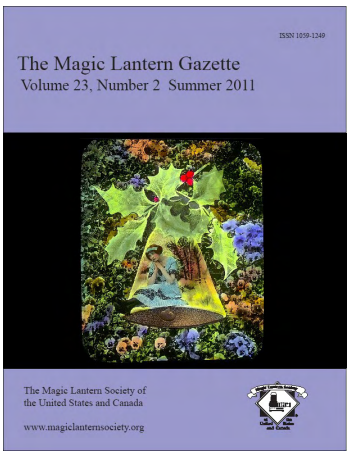
Entrants must be enrolled in a college or university academic program (undergraduate or graduate) at the time of submission. Students may submit essays originally written for academic courses, but may not submit anything previously published in print or online. Submissions should be written in English and should not exceed 5,000 words. All submissions are due electronically by **April 1, 2013.**

A committee of the Society will select the winner. The award, which consists of a monetary prize of US $500, will be announced on June 1, 2013, and the essay will be published soon thereafter in *The Magic Lantern Gazette*, the Society's print and on-line research journal. The winner will also be invited to make a presentation at the next convention of the Society, to be held in Boston in 2014.

Please send your submissions (in Microsoft Word format) to the editor of *The Magic Lantern Gazette*:

Kentwood Wells (kentwood.wells@uconn.edu

For more information about the Society, please visit www.magiclanternsociety.org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The first Student Essay Award was presented at the 2012 convention in Tacoma, Washington to **Esther Morgan-Ellis** of Yale University for her cover article in the Summer 2011 issue of the *Gazette*, entitled **Nostalgia, Sentiment, and Cynicism in Images of "After the Ball"**

Medallion made in 1929 to celebrate the 50th anniversary of the invention of the lightbulb by Thomas Edison in 1879. The actual medallion is about the size of a 50-cent piece; others were made in the size of a quarter. In our feature article, John Davidson discusses the use of antique and modern electric lightbulbs for magic lantern projection. Wells collection.

When formatting John Davidson's article for the Winter 2012 issue of the *Gazette*, your intrepid editor accidentally left out a section and some figures and duplicated another section. Here are the corrections.

►Read to the bottom of p. 9 and then insert the following text after **"….the results presented in Fig. 5."**

They are similar to those in **Fig. 4.** The slight dip at 40 inches is due to a small hole in the mirror to accommodate a striker used to light the acetylene lamp flame when used .with the Justrite lamp This mirror ran very hot even during the short period of the tests so I do not recommend it.

It should also be noted at this point that the creation of a profile at a single image size can be used to approximate ones at *any* size by simple scaling rules. The distance across the screen is scaled in a linear manner. Thus a 2X scaling would double the size of the projected image and a data point on the screen taken on the 1X scale at 4 inches would become a point on the 2X scale at 8 inches etc. *The Lux readings scale as to the projected ratio of the areas.* Thus a 2X linear expansion would *reduce* each Lux value by 4X, a 3X expansion by 9X, as shown in **Fig. 4A**. A 4X linear expansion would reduce lux readings by 16X etc. It should be noted that scaling in this manner keeps the total number lumens constant, a necessary condition which must be met due to conservation of energy considerations.

This can be seen in **Fig. 4a** for the data shown in **Fig. 4** in the case when a mirror is used. The noticeable "hot spot" in **Fig. 4** is smoothed out as the projected area becomes greater.

The same trends as noted with the Brenkert lantern were also observed when the FEV 200w bulb was used in a Perken, Son and Rayment lantern. As was mentioned earlier his British biunial lantern dates from the 1890's and was undoubtedly used with the lime light. It can be safely said that this lantern was never intended to be used with electric incandescent illumination. The illumination profiles are given in **Fig. 6** with a 2X scaling and **Fig. 7** with and without a mirror and exhibit the same general trend in the use of a spherical mirror behind the lamp as is shown for the Brenkert. The same 75mm diameter first surface 150mm radius mirror was used in both sets of experiments.

It should be noted at this point that **The Sylvania-Osram Co. does not recommend that quartz halogen bulbs be run at anything less than their rated voltages** due to uncertainty in the running of the tungsten-halogen cycle at other than the design voltage. Thus it is a real advantage to have a100watt and a 200 watt pair of bulbs which are interchangeable in the lantern, the choice being dictated by screen size and ambient light conditions. Nevertheless this same company sells quartz halogen bulbs designed for 130 volts which can be used at 120 volts with (hopefully) extended life. **Sylvania-Osram claims that a 130 volt quartz halogen bulb run at 120 volts will have twice the life on the former.** It will of course have a somewhat lower color temperature and light output of about 75-76% of the 130 volt value.

►Insert the following figures after Fig. 3 and before Fig. 7:

**Fig.4 Brenkert Biunial Model 01, 200W FEV bulb, series 1 with 75mm dia, 150mm radius mirror, series 2 W/O mirroor**

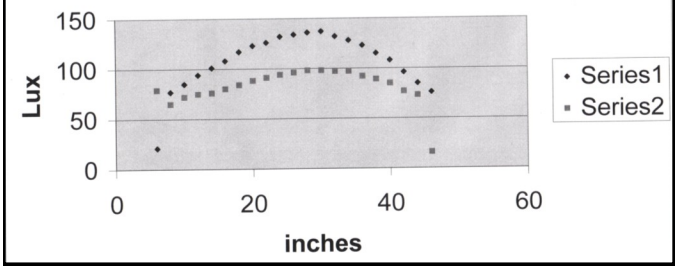



**Fig 4a. Image Profiles with mirror from fig 4, series 1, data (1X),series 2,expanded 2X, series 3, expanded 3X**

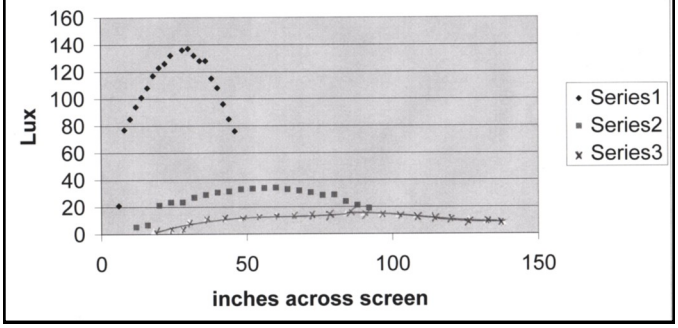
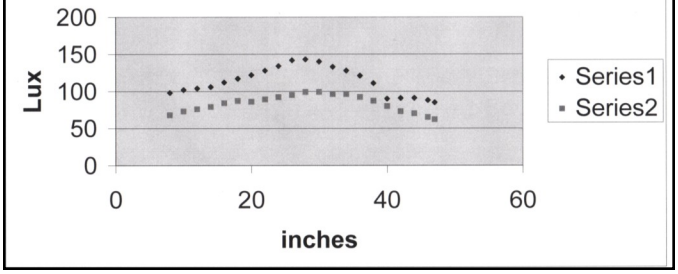
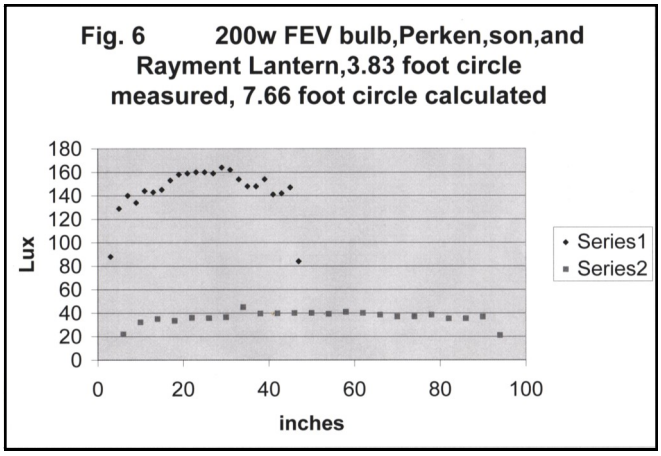



**Fig.5 Brenkert biunial top lantern,200w FEV bulb series #1 with Justrite carbide lamp reflector, 4.25in, series 2 w/o reflector**






►Read directly from p. 12 to p. 14—**skip p. 13**.

►**Acknowledgements**

The author would like to thank two members of the staff of the Dittrick Medical History center, Case Western Reserve University, for their assistance: Jenny Nieves, Museum Archivist and Registrar, for supplying up to date references on museum lighting practices. Laura Travis, Assistant Curator of Multi-Media and Communications, for assistance in UV measurements and in photography.